

Character state variation within *Dendrothrips* (Thysanoptera: Thripidae) with a revision of the species from China

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Abstract

Character state variation among species within *Dendrothrips* Uzel is discussed, with seven species-groups suggested based on sculpture of body and fore wing surface. Sexual dimorphism in pronotal sculpture and posteroangular setae is described in *D. magnoliae*. The major host plants of several species are indicated, and the wide distribution across Asia of some species emphasised. Species of *Dendrothrips* from China are reviewed, *D. octosparsus* sp. n. is described from Oleaceae, and a key presented to the ten species from China. Two species previously known only from Japan, *D. magnoliae* Kudô and *D. latimaculatus* Nonaka & Okajima, are newly recorded from China along with the first description of their males. The male of *D. homalii* Zhang & Tong is described and illustrated. The record from China of *D. mendax* Bhatti is considered a misidentification of *D. latimaculatus*. *D. schmieae* Kudô is synonymized with *D. minowai* Priesner.

Key words: species-groups, host plants, new species, new records, synonyms

Introduction

Dendrothrips Uzel is the largest genus of the Thripidae subfamily Dendrothripinae, and currently comprises 55 species (ThripsWiki 2019). Members of *Dendrothrips* are all leaf-feeding. They are found mainly in the Old World tropics and subtropics, but range from northern Europe through the Palaeotropics to South Africa and also to Japan and Australia (Alavi *et al.* 2014, Mound & Tree 2016). Host plant relationships of *Dendrothrips* species were discussed by Marullo (2003), who listed 27 species that were associated with 39 plant genera from 15 families. Several species are associated particularly with Oleaceae, but there is not enough evidence to consider any phylogenetic correlation between species and their host plants. For many species there is little or no information on the plant species on which the insects actually breed, and more than 10 species in *Dendrothrips* were described from one or two specimens. Not only is there a lack of distinction between the true breeding host of a thrips and any plants from which a few adults have been collected, but some descriptions have been published with no host information, such as *D. cibarius* despite being based on hundreds of individuals (Ananthakrishnan 1965).

Dendrothrips species are generally not considered as pests, however, *D. minowai* breeds primarily on the tender leaves of Theaceae. It is particularly associated with leaf damage on cultivated *Camellia sinensis*, and is one of the main pests in tea plantations in China (Zhao 1996 and personal observation by Xiaoli Tong). Similarly, *D. ornatus* is reported as causing serious damage to ornamental *Syringa* in Beijing (Chen *et al.* 1994 and personal observation by Xiaoli Tong). In Guangzhou, we have observed *D. latimaculatus* causing severe leaf damage to *Osmanthus fragrans* [Oleaceae].

Distribution patterns. Thrips taxonomists sometimes consider their local fauna as endemic, with minimal consideration of more extensive distributions across the flora of similar areas, such as India, southern China and Malaysia. For example, *D. minowai* was considered as a “Japanese species” (Priesner 1935; Kudô 1984), and a very similar species from Nepal, *D. schmieae*, was distinguished on very tiny differences but mainly because of the distribution difference (Kudô 1989). However, both were collected from Theaceae, and they are here considered to represent a single widespread species. Similarly, *D. utari* was described from Japan on *Fraxinus sieboldiana* [Oleaceae], but is scarcely distinguishable from the widespread Palearctic species *D. ornatus* that is common on

various Oleaceae (Kudô 1984). The problem is exacerbated by the lack of available specimens for many species. For example, there is no information as to where the types might now be deposited of most thrips species described from India (ThripsWiki 2019). As a result, species comparisons are often conjectural. Despite such problems, there is increasing information that some thrips species have wide distributions, such as between southern China and Australia (Zhang *et al.* 2018b), also between Europe and northern China (Mirab-balou *et al.* 2014).

From China, eight species of *Dendrothrips* have previously been listed (Mirab-balou *et al.* 2011). One species in that list is here recognized as a misidentification. With the description below of one new species, as well as two new records, a total of ten species of this genus are recorded from China, and a key to these is provided together with descriptions of the previously unknown males of three species.

Character state variation in *Dendrothrips*. There is considerable structural variation among species within this genus, including the number of antennal segments, the form of the antennal sense cones, the position of ocellar setae III, the presence or absence of prominent pronotal posteroangular setae, the number of sternal marginal setae, and the body colour and sculpture (Mound 1999; Mound & Tree 2016; Zhang *et al.* 2018).

1. *Number of antennal segments*: varying from 7 to 9, morphological segment VI sometimes with partial or complete suture; morphological segment VII sometimes fused to VI. Within species there is little variation in number of segments, although the suture across segment VI in *degeeri* varies from complete to incomplete. However, the number of antennal segments shows little correlation with variation in other character states.

2. *Shape of antennal sense cones*: in general, these structures are forked on segments III and IV. However, in *minowai* the sense cone is simple on both segments, and in several species it is forked on IV but simple on III, as in *aspersus*, *becii*, *jeanneli*, *rhigozi*, *varius*, *viticola* and *vitex*. On segment III the sense cone curves around the segment, and recognizing if it is forked or simple can be difficult, particularly if the two arms are asymmetric.

3. *Ocellar setae*: species of Dendrothripinae generally have three pairs of ocellar setae, but in *Dendrothrips williamsi* and *sensilli* there are five pairs of ocellar setae outside of the ocellar triangle. In most genera of Dendrothripinae ocellar setae pair III arise within the ocellar triangle, but in all *Dendrothrips* species (with the exception of *magnoliae* and *gutattus*) this pair of setae arises outside the triangle. Two species from southern Africa, *anneckeii* and *oatleyi*, have ocellar setae pair III large, almost as in *Ensiferothrips* species from Australia, whereas in other *Dendrothrips* species the ocellar setae are small.

4. *Maxillary palps*: although usually 2-segmented in *Dendrothrips*, some species have the distal segment constricted medially giving the impression of a third segment, and in *oatleyi* and *anneckeii* the palps are recorded as long and 4-segmented.

5. *Head sculpture*: the posterior part of the head is commonly more or less reticulate, but the sculpture of the ocellar region is often species specific, either reticulate (Fig. 1), or with small granulate tubercles (Fig. 2), or with irregular sculptured wrinkles (Fig. 3), although intermediate conditions also occur. The form of this sculpture is often interpreted as indicating relationships.

6. *Pronotum sculpture*: often complex but commonly forming two different patterns, either fully reticulate (Fig. 1) or with transverse lines (Fig. 3). The latter condition presumably arises through the progressive transverse elongation of the reticles. However, in several species the sculpture lines are more irregular and less well-defined (Figs 4, 9). Species with more elongate pronotal posteroangular setae usually have transverse sculpture. And in *magnoliae*, the pronotal sculpture exhibits remarkable sexual dimorphism (Figs 6, 7).

7. *Fore wing*: in all species of this genus the anteromarginal cilia arise ventrally and well-behind the apparent margin, and the wing apex is curved and lacks terminal setae, but the fore wing surface is variable in structure. At least 13 species, including *homalii*, *howei*, *saltator*, *sexmaculatus*, *strasseni* and *virgulatus*, have the fore wing surface uniformly covered with microtrichia (Figs 12, 15). In contrast, some other species, including *diaspora*, *julat-teni*, *magnoliae*, *minowai*, *viticola*, *vitex* and *williamsi*, have most of the surface uniformly covered in microtrichia but the first vein bears a row of conspicuously larger microtrichia (Fig. 13). Some species have no uniform microtrichia, but the veins bear large microtrichia and the surface bears irregular wrinkles (Figs 14, 16).

8. *Tergite sculpture*: the form of the sculpture on the lateral thirds of the abdominal tergites is largely species-specific, but is too complex to use to deduce relationships. However, species with similar tergal sculpture generally are closely related, such as *homalii* (Fig. 17), *howei* (Fig. 21) and *sexmaculatus* (Fig. 18) that have transverse lines and ridges on lines; *latimaculatus* (Fig. 20) and *octosparsus* (Fig. 23) with remarkable small circular granular areas.

9. *Sternite marginal setae*: as in most Thripidae, the sternites of *Dendrothrips* species bear three pairs of mar-

ginal setae, but the East African species, *jeanneli*, appears to be unique in having more than four pairs of such sternal marginal setae, and moreover has some of these setae on the discal area (Fig. 36).

Species relationships. Bhatti (1971) grouped the 13 *Dendrothrips* species from India into seven Sections, based on similarities in body sculpture and fore wing surface. However, information for many described species is not available, and some species are too aberrant to place into any of these groups. In the study presented here 34 of the 55 described species are included and placed in seven species-groups. However, neither the Sections given by Bhatti, nor the species groups discussed below, necessarily represent separate phylogenetic lineages. Relationships between species within this genus require further phylogenetic analysis.

I. *cameroni* species group (*albus*, *cameroni*, *elixae*, *faurei*, *fasciatus*, *punctatus*, *saltator*): fore wing upper surface uniformly covered with microtrichia; ocellar triangle with wrinkles; pronotum with transverse lines and inner markings between lines, long posteroangular setae present; tergites mostly reticulate. In this group, five species are from India, of which *albus*, *elixae*, and *faurei* were each described on a single specimen, and *punctatus* from two specimens; similarly *cameroni* from Sudan was based on two specimens.

II. *cibarius* species group (*aspersus*, *cibarius*, *glynn*, *latimaculatus*, *jasminum*, *multimaculatus*, *mendax*, *reticulatus*): fore wing without uniform covering of microtrichia but wrinkles on surface; ocellar triangle reticulate with inner dots; pronotum reticulate or irregularly reticulate, with internal dots, posterior margin with no long setae (Fig. 1); tergites with white and brown patches, sculpture complex, generally transversely reticulate on anterior half and with dots on brown areas (Figs 20, 23).

III. *diaspora* species group (*diaspora*, *julatteni*): fore wing almost uniformly covered with microtrichia, but first vein with larger microtrichia; ocellar triangle only with tubercles; pronotum with irregular complex reticulations, discal setae fine and posterior margin with no long setae (Fig. 2); tergites transversely reticulate on anterior half, with longitudinal ridges on posterior half (Fig. 32).

IV. *jeanneli* species group (*jeanneli*, *varius*): fore wing without uniform microtrichia, surface with wrinkles; ocellar triangle reticulate with inner dots; pronotum partly with transverse lines bearing inner markings and partly granulated, posterior margin with no long setae, but setae blunt (Fig. 9); tergites posterior half tuberculate, setae clearly blunt (Fig. 33).

V. *minutus* species group (*minutus*, *vitex*): fore wing without uniform microtrichia, microtrichia larger on both veins; ocellar triangle almost reticulate; pronotum with transverse lines bearing inner markings, posterior margin with no long setae; tergites with transverse reticles on anterior half, longitudinal reticles on posterior half.

VI. *ornatus* species group: (*becii*, *degeeri*, *ornatus*, *phyllireae*, *stannardi*, *utari*, *victoriae*): fore wing without uniform microtrichia but wrinkles on surface, microtrichia larger on both veins; ocellar triangle with wrinkles; pronotum with transverse lines bearing microflanges, without inner dots or wrinkles, posterior margin with no long setae (Fig. 3); tergites reticulate (Fig. 22).

VII. *sexmaculatus* species group: (*amamiensis*, *homalii*, *howei*, *sexmaculatus*, *strasseni* and *virgulatus*): fore wing upper surface uniformly covered with microtrichia (Fig. 12); ocellar triangle with irregular lines and dots; pronotum transversely reticulate with inner markings, without long setae (Fig. 5); tergites sculptured with transverse reticulations or transverse lines, with inner markings or ridges on lines (Figs 17, 18, 19, 21).

Material and methods

Many of the observations presented here are based on slide-mounted specimens in the Australian National Insect Collection, Canberra (ANIC). For new slide preparations, specimens were mounted in Canada balsam using the method outlined by Zhang *et al.* (2006). Details of the morphological structures were examined with a ZEISS Imager A1 microscope; the photos were taken by a Photometrics CoolSNAP camera. Specimens are deposited in the Insect Collection, South China Agricultural University (SCAU) and in ANIC.

Key to *Dendrothrips* species (females) from China

[* based on descriptions]

1. Ocellar setae pair III arise within the triangle between the posterior ocelli (Figs 6, 7) 2
- . Ocellar setae pair III arise outside the triangle, anterolateral to posterior ocelli (Fig. 1). 3

2. Pronotum reticulate with inner wrinkles (Fig. 6), fore wing without wrinkles on surface (Fig. 29), each tergite with similar sculpture, posterior half with dense tubercles (Fig. 34) *magnoliae*
- Pronotum reticulate with inner dots, fore wing with wrinkles on surface, tergite II reticulate with inner dots, different with tergite V *guttatus**
3. Antennae 7-segmented (Fig. 49) [body brown with pronotum and abdomen pale laterally (Fig. 67); fore wing without uniform covering of microtrichia (Fig. 14); pronotum with transverse and broken striae without internal dots or wrinkles (Fig. 11)] ... *stannardi*
- Antennae 8-segmented 4
4. Fore wing upper surface with distal two-thirds uniformly covered with equal sized microtrichia (Fig. 12). 5
- Fore wing upper surface with microtrichia on distal two-thirds not uniform in size, at least some veins with row of larger microtrichia (Fig. 13), or wrinkles but not microtrichia present between the veins (Fig. 14) 6
5. Abdominal tergites with lateral thirds brown (Fig. 17) *homalii*
- Abdominal tergites IV–VI with lateral thirds yellow, each with a pair of dark brown spots (Fig. 18) *sexmaculatus*
6. Fore wing with one pale cross band, distal half of wing uniformly dark (Fig. 13); antennal segments III–IV with sense cone simple (Fig. 44) *minowai*
- Fore wing with two or more pale cross bands, distal half of wing not uniformly dark; antennal segments III–IV with sense cone forked 7
7. Pronotum paler than head and pterothorax; pronotal surface with no dots or wrinkles between the weak transverse striations (Fig. 3); fore wing with four brown and three pale areas (Fig. 31) *ornatus*
- Pronotum as brown as head and pterothorax; pronotal surface strongly sculptured with dots or wrinkles between the main lines. 8
8. Pronotum not regularly reticulate, median transverse area without reticulations; tergites II–III paler than VII *multimaculatus**
- Pronotum covered with regular reticulations (Figs 1, 10); tergites II–III as dark as VII 9
9. Abdominal tergites IV–VI laterally with small circular area of granulate sculpture (Fig. 20) *latimaculatus*
- Only tergites V–VI laterally with small circular area of granulate sculpture, tergite IV lateral thirds with regular reticulation (Fig. 23) *octosparsus* sp. n.

Dendrothrips guttatus Wang

Dendrothrips guttatus Wang, 1993: 254.

This species was described based on a single specimen from *Aleurites moluccana* [Euphorbiaceae] in Taiwan. According to the original description, also judging from a photograph of the holotype that was kindly supplied by Chin-Ling Wang, it is similar to *latimaculatus* and *multimaculatus* but paler. It shares many character states with *cibarius* species-group: fore wing without uniform covering of microtrichia, surface with wrinkles; ocellar triangle reticulate with inner granules; pronotum reticulate with internal granules, posterior margin with no long setae and tergites sculpture complex. However, the original illustration of the head indicates that ocellar setae pair III are situated between the hind ocelli, in contrast to all other species of *Dendrothrips* apart from *magnoliae*.

Distribution: China (Taiwan).

Host plant: uncertain.

Dendrothrips homalii Zhang & Tong

(Figs 5, 12, 17, 38, 41, 50–51)

Dendrothrips homalii Zhang & Tong, 1988: 276.

The type specimens of *homalii* were collected from *Homalium hainanense* [Flacourtiaceae] in Hainan province, and a series including the male was collected recently from *Populus tomentosa* [Salicaceae] in Hunan, China. The type specimens have been compared with *D. howeii* from Lord Howe Island, Australia, a species that is also introduced to California (Hoddle *et al.* 2012). These two species are remarkably similar in color or structure, although the available males from Australia are paler than the available male from China. At present it is not possible to decide if they represent the same species. A further similar species is *strasseni* based on a single female from Mumbai, India, that is also recorded from Nepal by Kudô (1989).

Female body brown, abdominal tergites slightly paler medially (Fig. 50); antennal segment brown, III and IV paler; fore wing white in basal fifth, then brown to apex (Fig. 12). Antennae 8-segmented, III–IV each with a small forked sense cone. Head reticulate on occipital region, ocellar triangle finely tuberculate with weak lines; pronotum

transverse reticulate bearing inner winks and coarse granules, all setae minute but slightly thickened (Fig. 5). Mesonotum with transverse reticles; metanotum longitudinally striate, median setae arising in the middle. Fore wing with uniform microtrichia, venal setae small, first vein with 7 basal setae and 2 distal setae, second vein generally with 7–9 setae; clavus with 4+1 setae, the apical one longest and blunt. Abdominal tergites III–VIII with transverse anastomosing striae bearing short ridges (Fig. 17); tergite VIII with complete posteromarginal comb.

Male: similar to female (Fig. 51), but abdomen slender, antennae brown (Fig. 41), tergites IV–V pale (Fig. 38).

Material examined. Type series of *homalii* (in SCAU); Other specimens: **CHINA** (in SCAU), Hunan, Yiyang, Datonghu Town (29°11'39"N, 112°37'23"E), 8 females, 1 male collected from *Populus tomentosa* [Salicaceae], 7.xi.2016 (Xiaoli Tong).

Distribution: China (Hunan, Hainan)

Host plants: *Homalium hainanense* [Flacourtiaceae], *Populus tomentosa* [Salicaceae].

***Dendrothrips latimaculatus* Nonaka & Okajima**

(Figs 1, 20, 24, 27–28, 39, 42–43, 52–56)

Dendrothrips latimaculatus Nonaka & Okajima, 1991: 107.

Dendrothrips mendax; sensu Zhang, 1982: 53, not Bhatti, 1971.

This species has been found in South China specifically on the leaves of *Osmanthus fragrans* [Oleaceae]. This is a common ornamental plant, and is also an important spice crop. In Japan, the thrips was recorded on *Fraxinus griffithii* from Okinawa-ken, and this suggests it is associated with Oleaceae in Asian tropical areas. In Guangzhou, males of *latimaculatus* occur only during October, before the flowering of these plants. It clearly breeds on leaves, because after removing all adults and larvae from leaves further larvae were found to emerge on the same leaves. The record from China of *mendax* Bhatti was based on female specimens collected from the leaves of *O. fragrans* (Zhang 1982). Direct comparison of those specimens with *latimaculatus* makes it clear that these were misidentification of *mendax*. A further species to be considered, *cibarius*, was described from 110 females from leaves of one unidentified tree in Bombay, India (Ananthakrishnan 1965). According to the original illustrations, *cibarius* and *latimaculatus* share similar fore wing color, as well as sculpture on the head, pronotum and tergite VIII. *Osmanthus fragrans* is widely planted as an ornamental and spice crop, and there is a possibility that *cibarius* may be the same species as *latimaculatus*.

Female: Body brown, head and thorax darker than abdomen, tergites IV–VI paler laterally with 2 pairs of brown spots (Figs 52, 54); antennal segments I–II and VI–VIII brown, V pale brown, III–IV yellow (Figs 42); fore wing colour patterns complex (Fig. 27), basal fourth pale with brown spots, sub-basal fourth brown but slightly pale medially, apical half with two white and two brown areas alternating, apex brown; clavus brown at basal half. Head and pronotum reticulate with internal dots (Fig. 1). Mesonotum with transverse anastomosing striae; metanotum medially sculptured with irregular reticles bearing internal dots, lateral reticles bearing winks (Fig. 24). Fore wing without uniform microtrichia, vein setae small, first vein with 15–17 setae distributed discontinuous, second vein with 3–5 setae placed on brown areas. Abdominal tergites II–III and VII–VIII reticulate with numerous dots, IV–VI anterior 1/3 with transverse anastomosing striae bearing few dots, posterior 2/3 with dots on brown areas, different tubercles on yellow areas (Fig. 20); sternites reticulate with many longitudinal linear ridges, segments VII with 3 pairs of marginal setae in front of posterior margin.

Male: Paler and smaller than female (Fig. 53). Head, thorax and abdominal tergites II–IV & VII lateral third brown, tergites V–VI and VIII–X pale yellow. Antennal segments II–III pale, I & IV pale brown, V–VIII brown (Fig. 43). Legs pale brown with tarsi yellow. Fore wing pale at basal quarter, medially and sub-apically (Fig. 28), hind vein with 2 setae on distal half. Abdominal tergites II–IV & VII sculptured with reticles bearing inner dots, tergites V–VI with tubercles (Fig. 39).

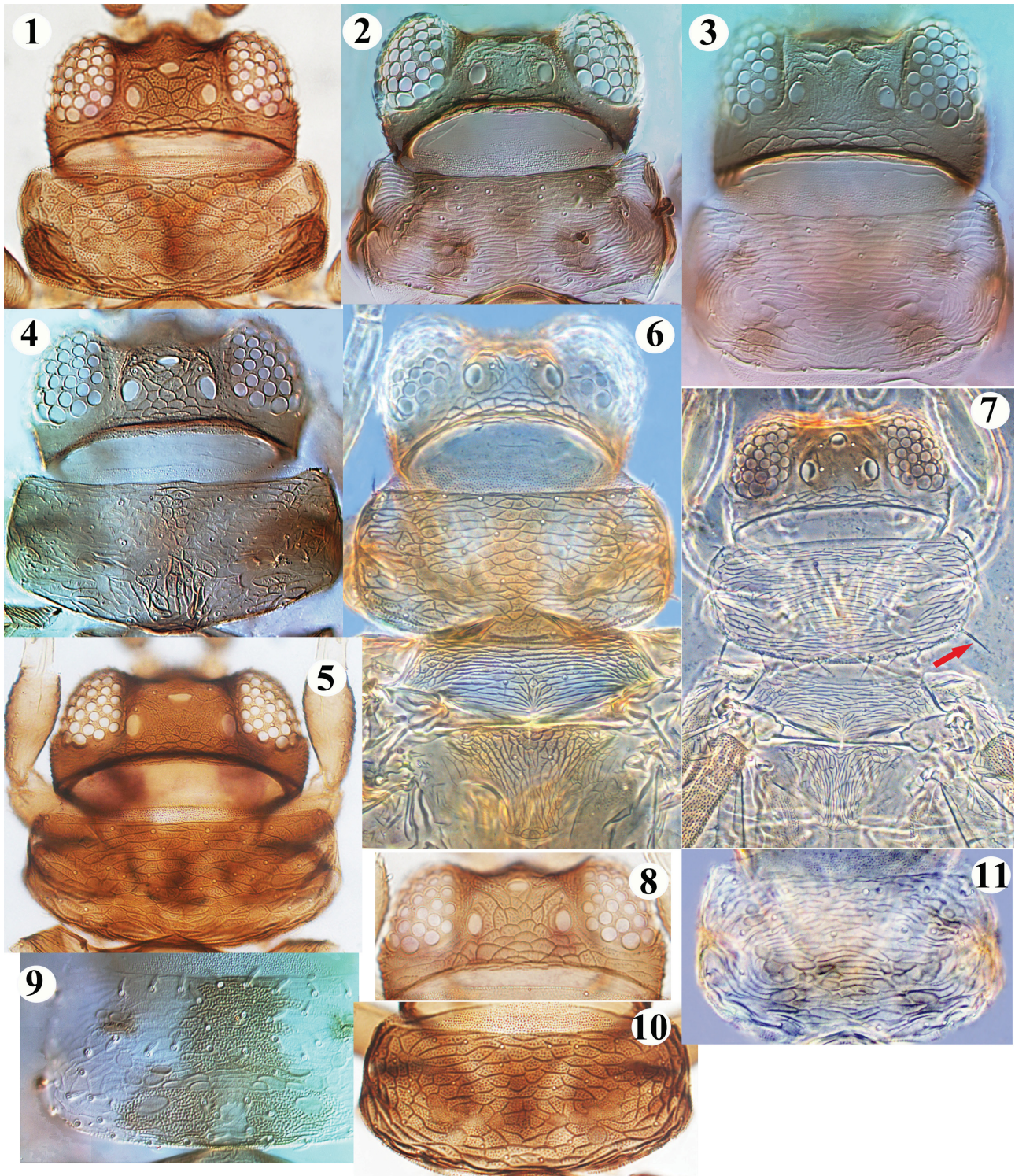
Larva. The first instar larvae completely pale; second instar pale but posterior half of mesonotum and anterior half of metanotum, abdominal tergites I–III and VII–VIII with bright red areas (Fig. 56).

Material examined. Paratype female of *latimaculatus*, **JAPAN** (in ANIC), Okinawa-ken, Ishigaki-jima Island, collected from leaves of *Ficus erectus* [Moraceae], 11.i.1991 (S. Okajima). **CHINA** (in SCAU), **Guangdong**, Guangzhou, SCAU (23°09'N, 113°21'E), 2 females collected from *Osmanthus fragrans* [Oleaceae], 27.xii.2012

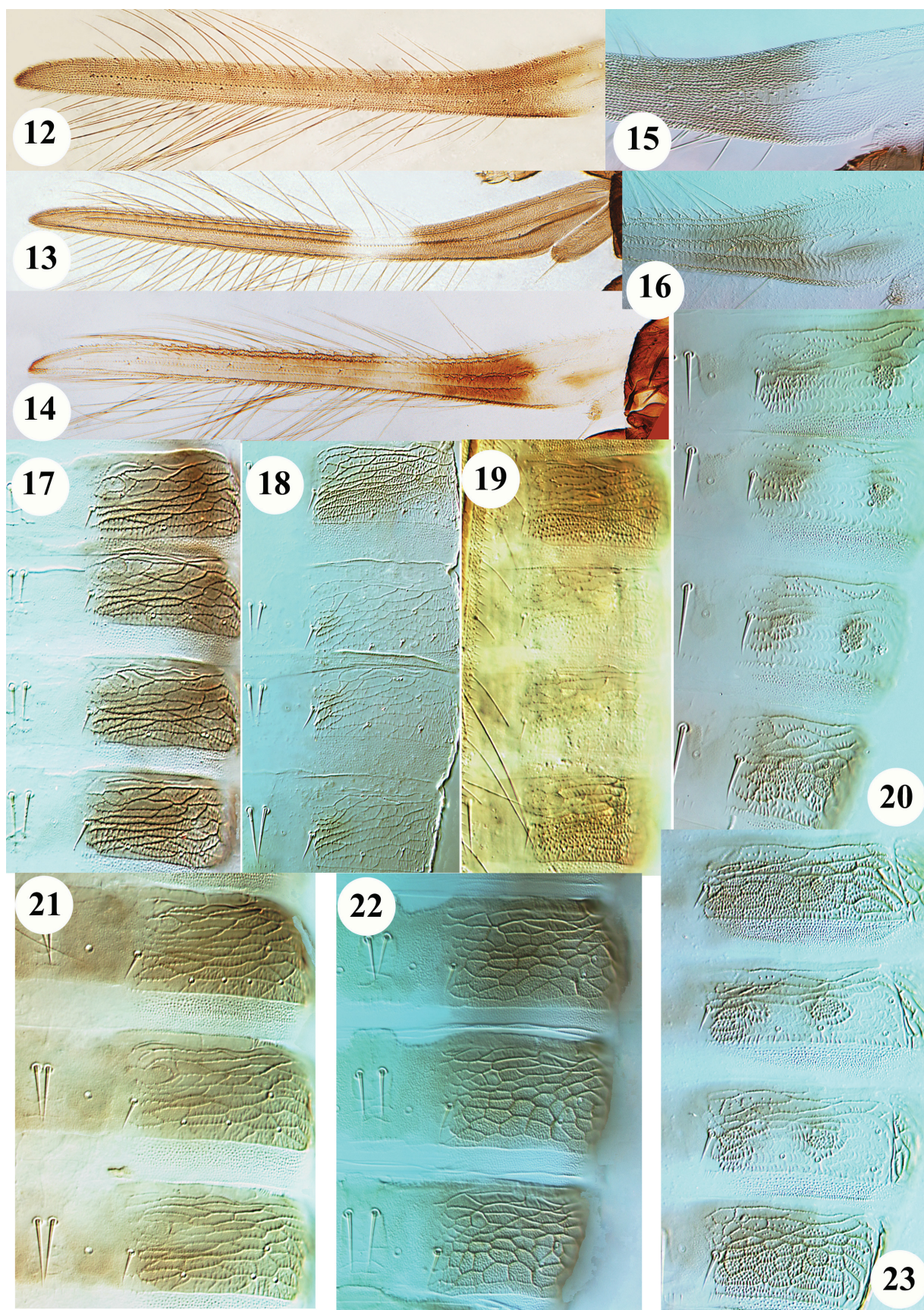
(Shulan Yang); 12 females, 24.ix.2015, 17 females, 30.ix.2015, 29 females and many larvae, 12.xii.2015, 8 females and many larvae, 26.ii.2016, 25 females, 3.iii.2016, 59 females, 25.iii.2016, 9 females on 2.iv.2016, 56 females, 12.v.2016, 44 females and many larvae, 21.vi.2016, 5 females and 5 males, 10.x.2016, all collected by Zhaohong Wang from *O. fragrans*.

Distribution: China (Jiangxi, Guangdong, Taiwan), Japan (Okinawa-ken).

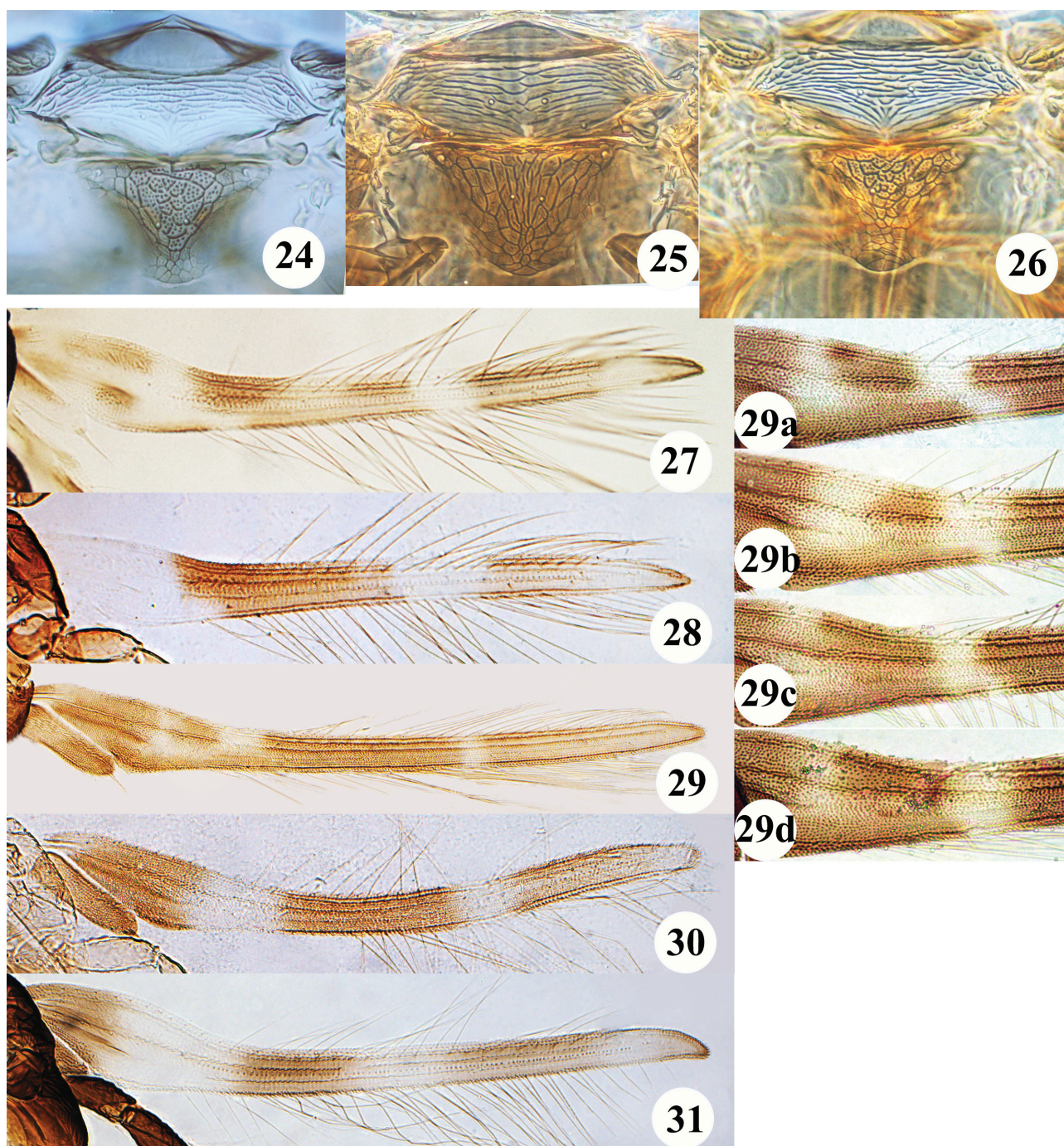
Host plants: *Osmanthus fragrans*, *Fraxinus griffithii* [Oleaceae].



FIGURES 1–11. *Dendrothrips*. Head and pronotum 1–5: (1) *latimaculatus*; (2) *diaspora*; (3) *ornatus*; (4) *minowai*; (5) *homalii*. Head and thorax of *magnoliae* 6–7: (6) female; (7) male. (8) Head of *octosparsus* **sp. n.** Pronotum 9–11: (9) *jeanneli*; (10) *octosparsus* **sp. n.**; (11) *stannardi*.



FIGURES 12–23. *Dendrothrips*. Fore wing 12–16: (12) *homalii*; (13) *minowai*; (14) *stannardi*; (15) *howeii*; (16) *stannardi*. Tergites 17–23: (17) *homalii* III–VI; (18) *sexmaculatus* III–VI; (19) *virgulatus* III–VI; (20) *latimaculatus* IV–VII; (21) *howeii* III–V; (22) *ornatus* IV–VI; (23) *octosparsus* **sp. n.** IV–VII.



FIGURES 24–31. *Dendrothrips*. Meso- and metanotum 24–26: (24) *latimaculatus*; (25) *ornatus*; (26) *octosparsus* **sp. n.** Forewing 27–31: (27) *latimaculatus* female; (28) *latimaculatus* male; (29) *magnoliae* female; (30) *magnoliae* male; (31) *ornatus*.

***Dendrothrips magnoliae* Kudô**

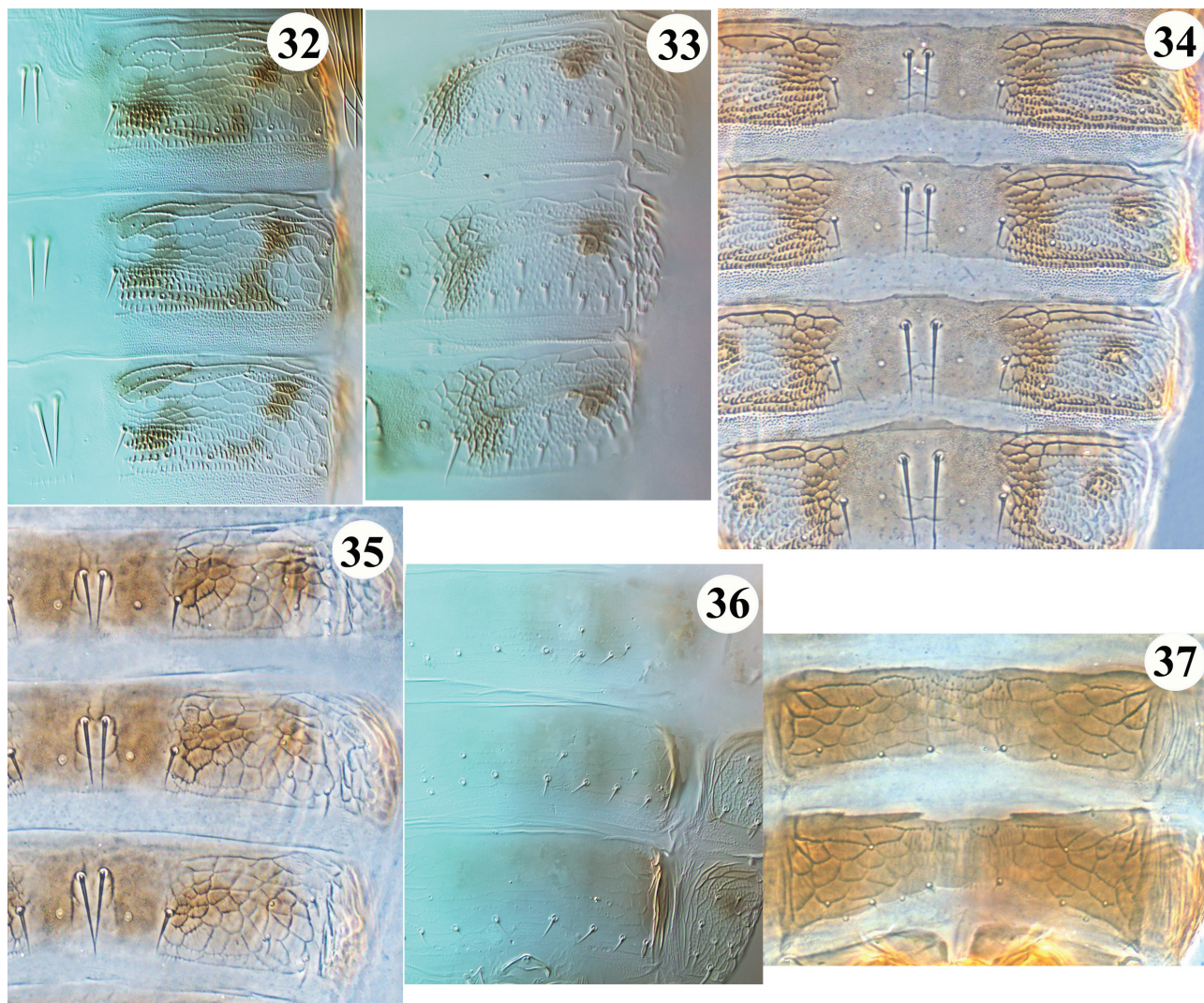
(Figs 6–7, 29–30, 34, 45–46, 57–58)

Dendrothrips magnoliae Kudô, 1984: 494.

This species seems to be particularly unusual within *Dendrothrips* in having ocellar setae pair III within the ocellar triangle, a condition shared only with *guttatus*. The pronotal sculpture is remarkably sexually dimorphic, and demonstrates an interesting correlation between the presence of pronotal transverse striae and longer posteroangular setae (in males), in contrast to a reticulate pronotum and no long setae (in females). The original females were de-

scribed from Japan on *Magnolia kobus* [Magnoliaceae], but specimens from China were collected from an unrelated deciduous broad-leaved tree species, *Ulmus pumila* [Ulmaceae]. The original description of the species indicated that the female has antennal segments II–V yellow, but specimens from China have segment II brown, at least clearly darker than III (Fig. 45). The extent of the sub-basal pale areas on the fore wing are variable (Figs 29).

Female: Body brown with clear pale area (Fig. 57), head brown with interocellar area pale, pronotum brown with four longitudinal light patches, mesonotum with pale patches posterolaterally (Fig. 6), abdominal tergites V–VII laterally with annular pale areas, tergites VIII–X paler with brown patches. Fore wing brown with irregular sub-basal pale area and a small pale band in the middle (Fig. 29). Antennae pale, segment I (or I–II), distal half of VI and VII–VIII brownish; segments III–IV with forked sense cones (Figs. 45). Head with irregular reticles, ocellar setae III situated between hind ocelli; pronotum reticulate with inner wrinkles, mesonotum with transverse striae and metanotum with longitudinal reticles bearing wrinkles; tergites II–VIII posterolaterally with numerous tubercles in transverse lines (Fig. 34); sternite VII with 3 pairs of setae in front of margin.



FIGURES 32–37. *Dendrothrips*. Tergites 32–35: (32) *diaspora* IV–VI; (33) *jeanneli* IV–VI; (34) *magnoliae* IV–VII; (35) *stan-nardi* V–VII. Sternites 36–37: (36) *jeanneli* V–VII; (37) *octosparsus* sp. n. VI–VII.

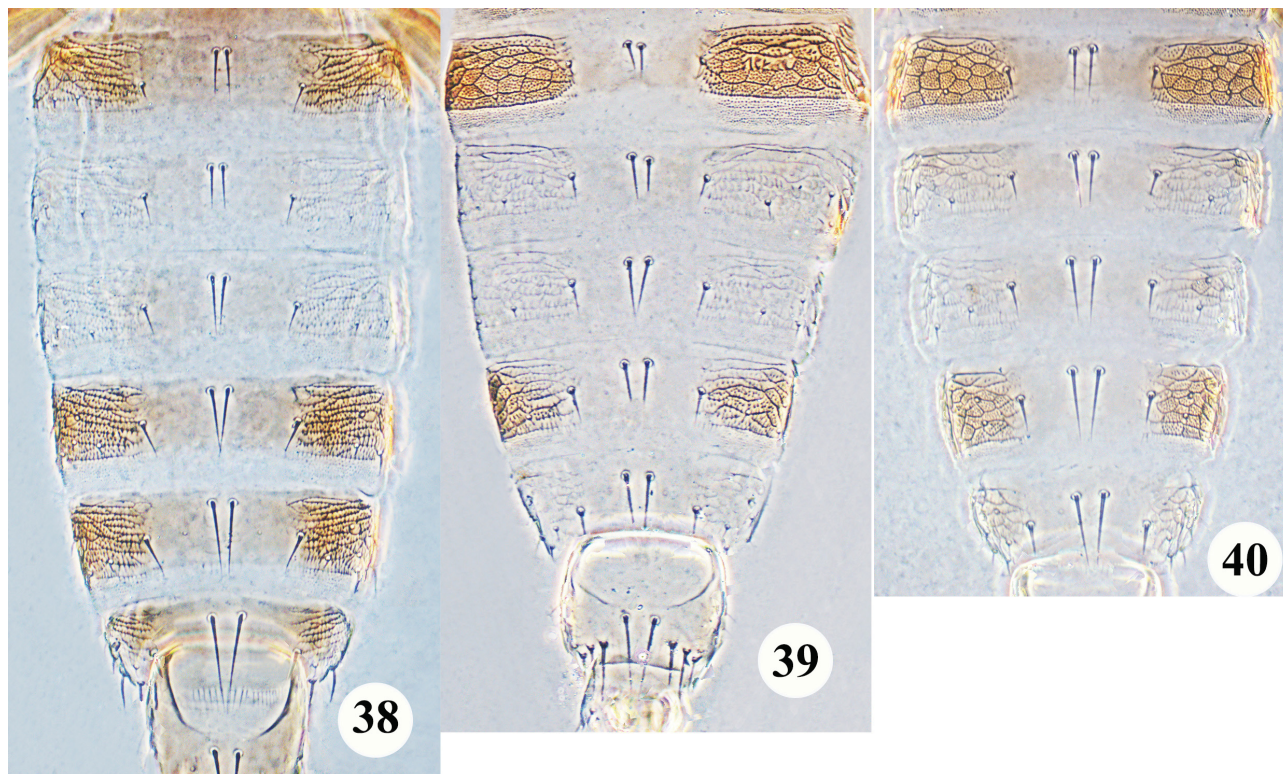
Male: Body including legs pale (Fig. 58), head brown with occipital region paler; antennal segments I–V pale, VI–VIII pale brown (Fig. 46); fore wing brown with 2 pale areas, sub-basally and sub-apically (Fig. 30). Head smooth except occipital region sculptured with transverse reticles, ocellar setae pair III arising between hind ocelli. Antennae 8-segmented, segment VI with an incomplete suture; sense cones on III and IV small and U-shaped, sense cone on VI arising near middle of segment. Pronotum with transverse anastomosing striae bearing no internal markings, 3 pairs of posteromarginal setae prominent, 1 pair of posteroangular setae longest (Fig. 7). Mesonotum with

transverse anastomosing striae; metanotum longitudinally striate without markings. Abdominal tergites III–VIII laterally with transverse anastomosing lines bearing small tubercles, lines on tergite IX bearing microtrichia.

Material examined: CHINA, Shandong (in SCAU), Zhangqiu, Duo Zhuang Reservoir (36°29'12"N, 117°24'26"E), 2 females 2 males collected from *Ulmus pumila* [Ulmaceae], 9.x.2017 (Zhaohong Wang). Jilin (in ANIC), Mt. Changbai, 1 female from canopy of trees, 11.viii.2016 (Cui Yanze).

Distribution: China (Jilin, Shandong), Japan (Honshu).

Host plants: *Magnolia kobus* [Magnoliaceae].



FIGURES 38–40. Male tergites: (38) *homalii* III–IX; (39) *latimaculatus* IV–IX. (40) *octosparsus* sp. n. IV–VIII.

***Dendrothrips multimaculatus* Nonaka & Okajima**

(Fig. 66)

Dendrothrips multimaculatus Nonaka & Okajima, 1991: 110.

The original description was detailed and based on six females and one male collected from *Quercus* sp. [Fagaceae] in Taiwan. These specimens have not been studied, but photos of one paratype were provided by Chin-Ling Wang. Superficially this specimen appears similar in appearance to *latimaculatus*, but differs in having the pronotum irregularly reticulate, and the fore wing and tergite III much paler.

Distribution: China (Taiwan).

Host plant: *Quercus* sp. [Fagaceae].

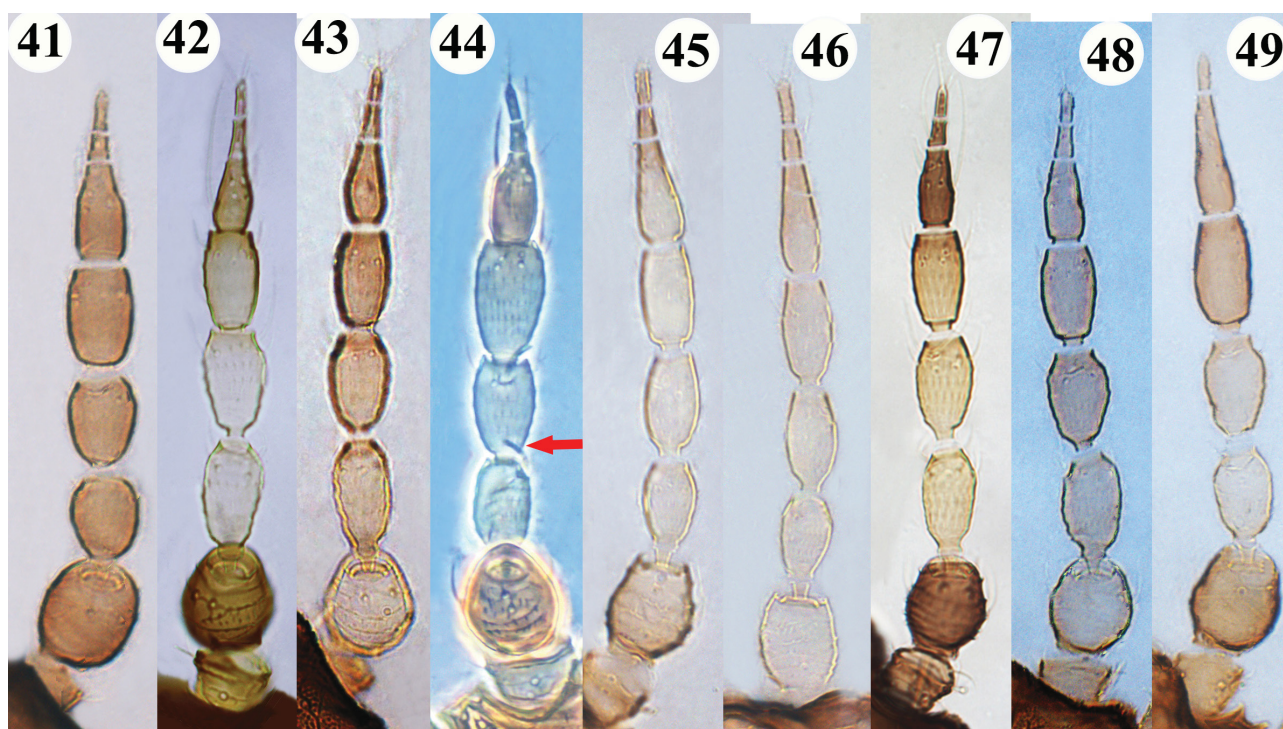
***Dendrothrips minowai* Priesner**

(Figs 4, 13, 44, 59–60)

Dendrothrips minowai Priesner, 1935: 353.

Dendrothrips schimae Kudô, 1989: 42. **Syn.n.**

A full description of *minowai* was provided by Kudô (1984), and further details are given by Kudô (1989). It was regarded as rare and endemic to Japan (Kudô, 1984), but judging from the specimens listed below this thrips specifically feeds on the leaves of *Camellia*, particular on the most widely planted species, *C. sinensis*. It is known as a pest of tea crops in China (Xu *et al.* 2016), and can be collected in almost every tea garden. Since southwest China is the original center of *Camellia*, and tea plantations originated in China (Zhang *et al.* 2018c), *minowai* is probably originally from southwest China and spread to other tea cultivating areas. The species *schimae* was described from Nepal on the assumption that *minowai* is endemic to Japan. The differences between them provided by Kudô (1989) have been demonstrated as variations in populations from China. Specimens of *minowai* have 7–10 pairs of setae on tergites IV–VI, fore wing with 0–1 setae on hind vein, all setae on sternite VII situated on posterior margin or setae S2 and S3 in front of the posterior margin.

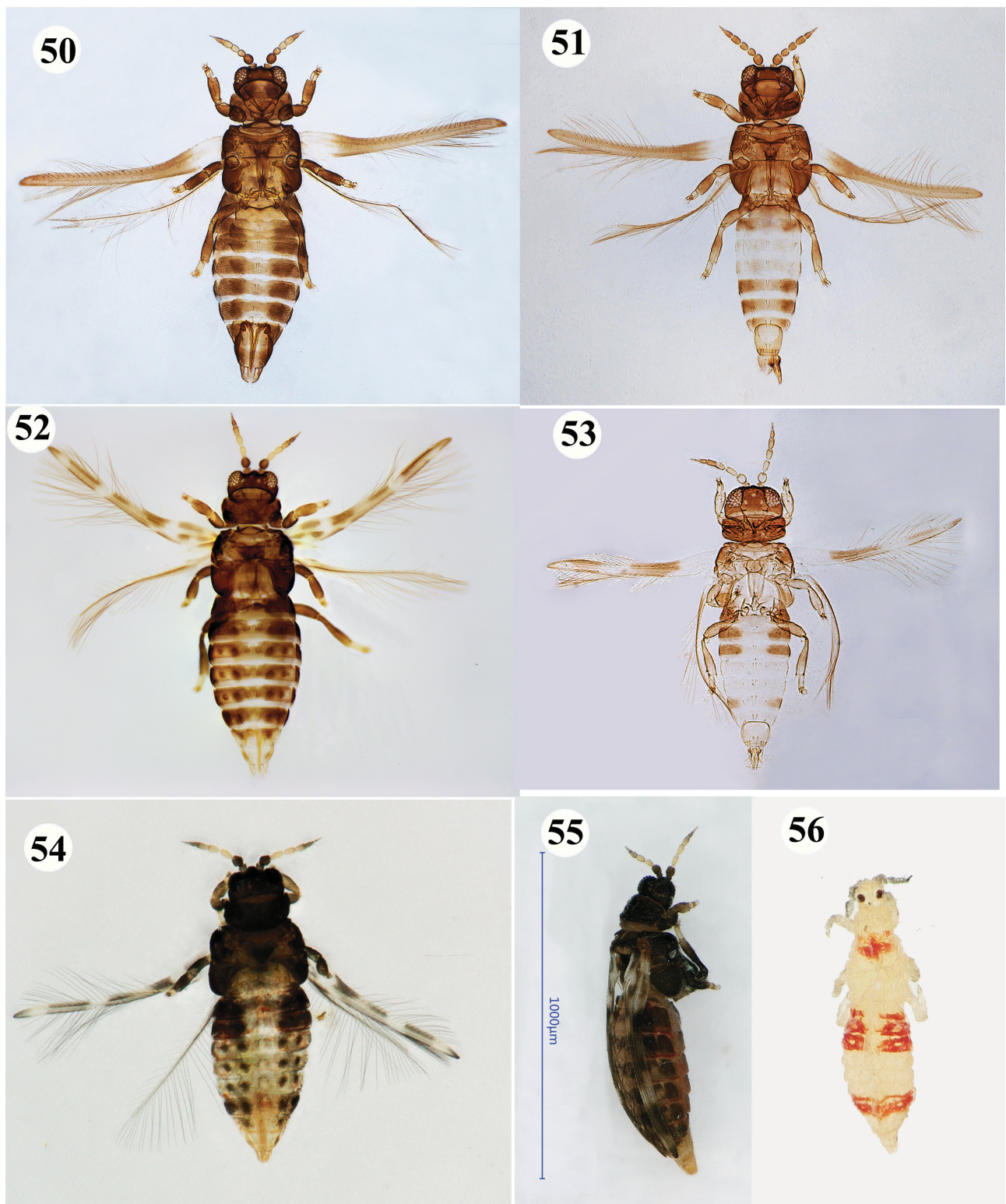


FIGURES 41–49. Antenna: (41) *homalii* male; (42) *latimaculatus* female; (43) *latimaculatus* male; (44) *minowai*; (45) *magnoliae* female; (46) *magnoliae* male; (47) *octosparsus* sp. n. female; (48) *octosparsus* sp. n. male; (49) *stannardi*.

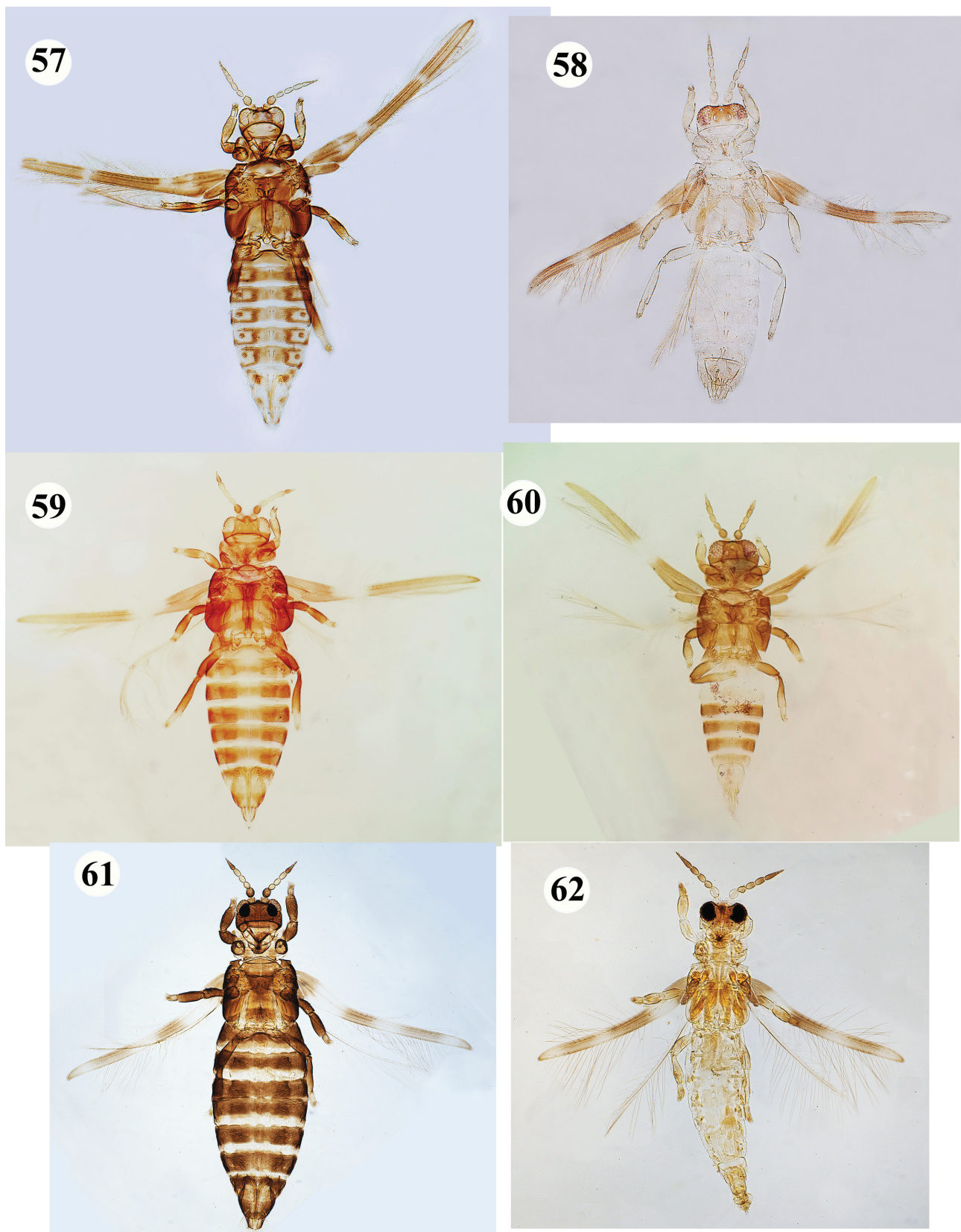
Distribution: China (Jiangsu, Hunan, Jiangxi, Yunnan, Guizhou, Guangxi, Guangdong, Hainan, Fujian, Taiwan); Japan, India, Nepal.

Host plants: *Camellia sinensis*, *C. japonica*, *Camellia* sp.; *Schima willichii*, *Schima* sp. [Theaceae].

Material examined: **CHINA** (in SCAU), **Yunnan**, Menlun, Xishaungbanna Tropical Botanical Garden (21°55'N, 101°16'E), 15 females collected from *Camellia japonica* [Theaceae]. **Guizhou**, Guiyang (26°38'N, 106°36'E), 6 females and 2 males from *C. sinensis*. Jinzhu (26°29'N, 106°41'E), 5 females from *C. sinensis*. **Hunan**, Yanling, Shennonggu National Nature Reserve (26°29' 44"N, 113°02'15"E, alt. 860m), 5 females from *Camellia* sp. Rucheng, Sanjiangkou Town (25°47'05"N, 113°88'57"E), 4 females 3 males from *Schima* sp. [Theaceae]. **Jiangxi**, Chongyi, Yangling National Forest Park (25°39'N, 114°18'E), 7 females and 3 males from *C. sinensis*. **Guangdong**, Guangzhou, Conghua, Liuxihe Forest Park (23°72'03"N, 113°74'84"E), 1 female from leaf litter. Shipai (23°09'N, 113°20'E), 1 female from *Homalium hainanense* [Flacourtiaceae]. Arboretum of SCAU (23°09'22"N, 113°21'15"E), 3 females from leaf litter. Fengkai, Pingfeng Twon (23°30'56"N, 111°48'16"E) 1 female from *Cinnamomum* sp. [Lauraceae]. Yunan, Dawangshan National Forest Park (23°25'26"N, 111°54'34"E), 12 females and 1 male from *Camellia* sp. Xinyi, Mt. Tianmashan (22°27'N, 110°41'E), 13 females from *C. sinensis*. Shenzhen, Mt. Wutongshan (22°24' N, 113°17'E), 4 females and 1 female from *C. sinensis*. Gaozhou, Yuntan Town, Mt. Sanguan-shan (21°55'10"N, 111°8'40"E), 1 female from *Eurya* sp. [Theaceae]. **Hainan**, Jianfengling National Forest Park (18°43'N, 108°57'E), 13 females from *C. japonica*.



FIGURES 50–56. *Dendrothrips. homalii* 50–51: (50) female; (51) male. *latimaculatus* 52–56: (52) female; (53) male; (54–55) females in original color; (56) second star larva.



FIGURES 57–62. *Dendrothrips. magnoliae* 57–58: (57) female; (58) male. *minowai* 59–60: (59) female; (60) male. *ornatus* 61–62: (61) female; (62) male.

***Dendrothrips octosparsus* sp. n.**

(Figs 8, 10, 23, 26, 37, 40, 47–48, 63–64)

Female: Body mainly brown (Fig. 63), abdominal tergites V–VI paler with 2 pairs of brown spots on lateral thirds (Fig. 23), tergites VIII–X slightly paler than VII. Antennal segments I–II and VI–VIII brown, III–V paler (Fig. 47); fore wing brown with 3 pale areas: basal fifth (with brown spots at extreme base), medially and sub-apically; clavus pale with base shaded; legs brown but tarsi yellow.

Head (Fig. 8) about 2.5 times as wide as long, ocellar triangle reticulate with dots; ocellar setae minute, pair II situated lateral to fore ocellus, pair III in front of hind ocelli; frons covered with vermiform wrinkles, with 2 pairs of stout setae near bases of antennae; maxillary palps 2-segmented. Antennae 8-segmented, segment II with transverse striae, III–IV with forked sense cone, VI with inner long sense cone arising near medial of segment and extending to apex of VIII; microtrichia rows present on segments III–VI. Pronotum (Fig. 10) 2.2–2.6 times as wide as long, sculptured with transverse reticles bearing strong granules, median reticles indistinct and all setae minute. Mesonotum (Fig. 26) with transverse anastomosing striae bearing few dots, median setae situated medially; metanotum with dots in median reticles, with wrinkles in lateral reticles. Fore wing without uniform microtrichia, first vein with 14–20 minute setae, second vein with one seta in subapical brown area or without setae. Abdominal tergites with complex sculpture (Fig. 23), tergites II–IV & VII sculptured with reticles bearing inner dots, but anterior reticles transverse with fewer inner dots; tergites V–VI anteriorly with dots in transverse reticles, posteriorly with tubercles on yellow areas and dots on brown areas; tergite VIII laterally reticulate with granules or ridges, posterior margin with comb of microtrichia; tergite IX laterally with microtrichia on striae, posteromarginal setae S1 almost as long as S2; IX–X with microtrichia on posterior half. Sternites reticulate with longitudinal linear markings; sternites II–III with 2 pairs of marginal setae, sternites IV–VI with 3 pairs of marginal setae, S1 & S2 situated on posterior margin, S3 generally in front of posterior margin; sternite VII with S2 & S3 in front of posterior margin, 1 pair of minute anterolateral pores in front of S2, 2 pairs of minute setae on posterior margin situated on either side of S2 (Fig. 37).

Measurements (holotype female in microns). Total distended body length 880. Head length (width) 60 (150); eye length (width) 50 (35). Pronotum length (width) 75 (180). Length of antenna 170; length (width) of antennal segments I 17 (21), II 25 (27), III 33 (19), IV 30 (19), V 25 (16), VI 20 (11), VII 10 (5) and VIII 10 (4). Fore wing length 650.

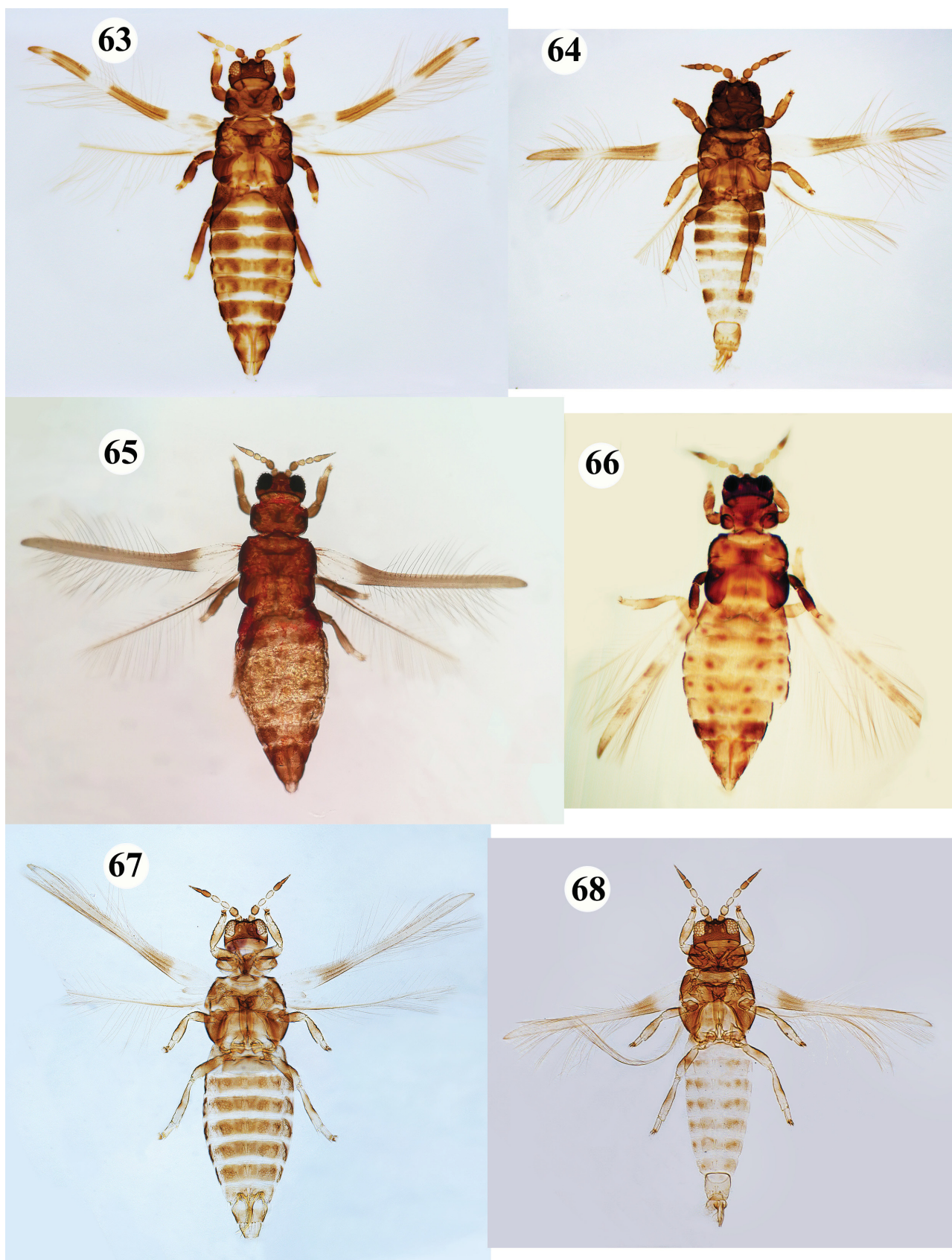
Male: Smaller and paler (Fig. 64), abdomen more slender. Head, thorax and lateral areas of abdominal tergites II–IV brown, tergite VII (and sometimes anterior of tergite V) pale brown, tergites V–VI and VIII–X pale yellow; antennae almost brown (Fig. 48); legs brown with tarsi yellow; fore wing brown with basal quarter and median 1/8 pale. Abdominal tergites II–IV & VII sculptured with reticles bearing inner granules, tergites V–VI with short longitudinal lines in reticles (Fig. 40).

Measurements (paratype male in microns). Total distended body length 750. Head length (width) 50 (125); eye length (width) 50 (35). Pronotum length (width) 65 (145). Length of antenna 160; length (width) of antennal segments I 14 (19), II 26 (22), III 33 (16), IV 26 (17), V 27 (15), VI 17 (11), VII 8 (5), VIII 9 (3). Fore wing length 475.

Material examined. Holotype female (in SCAU): **CHINA, Shandong**, Zhangqiu, Baimai Springs Park (36°43'10"N, 117°31'56"E), collected from leaves of *Ligustrum* sp. [Oleaceae], 2.viii.2016 (Zhaohong Wang). Paratypes (in SCAU): 30 females and 9 males collected with holotype (with one female and 1 male in ANIC). **Shaanxi**, Xi'an, Yangling (34°16'N, 108°04'E), 2 females from *Ligustrum quihoui*, 10.vi.2012 (Majid Mirab-balou). **Sichuan**: Chengdu, Chengjia (30°10'N, 103°22'E), 14 females from *L. quihoui*, 3.ix.2015 (Zhaoyun Lü). **Chongqing**, Dazu, Shuangqiao (29°29'N, 105°46'E), 6 females, host unknown, 26.vii.2016 (Jie Jiang). **Hubei**, Huanggang, Huanggang Normal University (30°26'N, 114°56'E), 11 females from *L. vicaryi*, 22.vi.2014 (Chao Zhao). **Hunan**, Yanling, Shennonggu National Nature Reserve (26°30'N, 113°59'E), 1 female 2 males from shrub, 25. viii. 2015 (Zhaohong Wang); Yiyang, Datonghu Twon (29°11'39"N, 112°37'23"E), 25 females collected from *Osmanthus fragrans*, 7.xi.2016 (Xiaoli Tong); Chaling County, Yunyangshan National Forest Park (26°47'58"N, 113°30'18"E), 12 females 2 males from leaves of *Ligustrum* sp., 8.viii.2017 (Zhaohong Wang). **Jiangxi**, Jiujiang, Mt. Lushan (29°33'N, 115°59'E), 2 females 4 males from *L. sinense*, 9.xi.2015 (Xiaoli Tong). **Guangxi**, Hezhou, Guposhan National Forest Park (24°59'55"N, 111°56'73"E), 7 females from *Ligustrum* sp., 17.ix.2015 (Chao Zhao).

Distribution: China (Shandong, Shaanxi, Sichuan, Hubei, Hunan, Jiangxi, Guangxi).

Host plants: *Ligustrum quihoui*, *L. sinense*, *L. vicaryi*, *Ligustrum* sp.; *Osmanthus fragrans* [Oleaceae].



FIGURES 63–68. *Dendrothrips. octosparsus* **sp. n.** 63–64: (63) female; (64) male. (65) *sexmaculatus*. (66) *multimaculatus*. *stannardi* 67–68: (67) female; (68) male.

Etymology. Specific epithet *octosparsus* is derived from Latin *octo* (eight) and *sparsus* (spot), refers to the abdominal tergites V–VI with eight brown spots.

Comments. This species shares morphological affinity with members of *cibarius* species group in sculpture of body and fore wing surface, and in this group, it is particularly similar to *latimaculatus*, but can be distinguished by the following combination: (1) tergites V–VI paler than tergites IV and VII, with two pairs of lateral brown spots (Fig. 23), while in *latimaculatus*, tergites IV–VI paler than III and VII (Fig. 20); (2) female fore wing with sub-basal area dark brown, hind vein has 0–1 setae (vs. female fore wing of *latimaculatus* sub-basal brown band with paler area medially, hind vein with 3–5 setae); (3) male fore wing brown at apical 1/3 (vs. male fore wing pale sub-apically); (4) male abdominal tergites V–VI with short longitudinal lines in reticles (Fig. 40) (vs. tergites V–VI with tubercles, Fig. 39). Specimens in different populations from several provinces in China show few variations, the color pasterns of fore wing and tergites are consistent among populations.

***Dendrothrips ornatus* (Jablonowski)**

(Figs 3, 22, 25, 31, 61–62)

Thrips ornatus Jablonowski, 1894: 93.

Dendrothrips tiliae Uzel, 1895: 160.

Information about this species is provided by Mound *et al.* (2018). The species is distinguished from other members of the genus by the fore wing color patterns (Fig. 31) and the pronotal sculpture (Fig. 3). It is a palearctic species feeding, breeding and pupating on the leaves of privet hedges, *Ligustrum* [Oleaceae], and also associated with leaves of *Syringa* [Oleaceae] (Mound *et al.* 2018), from which plant it has been reported in Beijing. A similar species, *utari* Kudô (1984), collected in Nagano, Japan from *Fraxinus sieboldiana* [Oleaceae], is only weakly distinguished from *ornatus*.

Material examined: CHINA (in SCAU), **Beijing**, Yunmengshan Forest Park (40°33'N, 116°42'E), 3 females collected from leaf litter of *Syringa* sp. [Oleaceae], 16.xi.2008 (Jun Wang). **GERMANY** (in SCAU), **Hessen**, Main, Hattersheim, 1 male, 1 female from *S. vulgaris*, 30.ix.1970 (R. zur Strassen). **FRANCE** (in ANIC), **Vende**, St Hilaire de Riez, 7 females from *Ligustrum vulgare* [Oleaceae], 9.viii.2005 (P. Reynaud). **HUNGARY** (in ANIC), 10 females from *Ligustrum*, iv.2006. **ENGLAND** (in ANIC), **Dorset**, Verwood, 1 female from *Ligustrum*, 15.viii.1964 (L.A. Mound).

Distribution: China (Beijing, Liaoning); widespread in Europe, and introduced to North America.

Host plants: *Syringa*, *Ligustrum*. [Oleaceae].

***Dendrothrips sexmaculatus* Bagnall**

(Figs 18, 65)

Dendrothrips sexmaculatus Bagnall, 1916: 401.

Described from Sri Lanka, and recorded widely in India (Tyagi, 2016), the record of this species from China was in a research report from Hainan province (Gu & Chen, 1987) and repeated by Han (1997), but the number of specimens and the depositary are unknown.

Female: Body brown, abdominal tergites IV–VI pale with 1 pair of brown spots near submedian setae (Fig. 65); antennae brown, but segments III–V paler; fore wing brown but white in basal fifth. Antennae 8-segmented, III–IV with forked sense cones. Head and pronotum reticulate with inner dots, all setae minute; mesonotum with transverse reticles; metanotum longitudinally striate with inner markings. Fore wing veinal setae small, first vein with 7 basal setae and 3 distal setae, second vein generally with 8–10 setae. Abdominal tergite III with transverse anastomosing striae bearing inner granules, tergites IV–VI with short ridges and fewer dots (Fig. 18); tergite VIII with complete posteromarginal comb.

Male: Similar to female, but abdomen slender, tergites IV–V and VIII–X pale.

Material examined: **SOUTH AFRICA** (in ANIC), Transvaal, Pretoria, 2 females collected from *Dovyalis caffra* [Salicaceae], 21.xii.1959 (J.C. Faure).

Distribution: China (Hainan), India (Karnataka, Kerala, West Bengal), Sri Lanka (Peradeniya), South Africa (Pretoria).

Host plants: possibly plants in Flacourtiaceae or Salicaceae.

***Dendrothrips stannardi* (Ananthakrishnan)**

(Figs 11, 14, 16, 35, 49, 67–68)

Dendrothripiella stannardi Ananthakrishnan, 1958: 216.

Described from southern India, reputedly from *Cinchona* [Rubiaceae], this species is quite common in southwest China, and is generally associated with *Buddleja* [Scrophulariaceae] (Han 1997 and this study). It is unique among species of *Dendrothrips* from China in having 7-segmented antennae, with antennal segments VI and VII fused together, leaving VIII as the visible seventh segment (Fig. 49), and it is also easily recognized by the rather regular polygonal tergal reticulations (Fig. 35).

Female: Body mainly brown, pronotum and lateral areas of abdomen paler (Fig 67); antennae brown but segments III–IV pale; fore wing pale at base, subbase brown, apical half pale brown to pale. Antennae 7-segmented, III–IV with forked sense cones. Head reticulate posteriorly, pronotum with transverse and irregular striae bearing microflanges, without internal markings (Fig. 11). Mesonotum with transverse reticles; metanotum with longitudinal reticles bearing inner markings. Fore wing surface with wrinkles and larger microtrichia on veins (Fig. 14), first vein with 13 setae and second vein with 3 setae. Abdominal tergites laterally with polygonal reticulations (Fig. 35), posterior margin with short microtrichia.

Male: similar to female, but abdomen slender and paler (Fig. 68).

Material examined: CHINA (in SCAU), Hubei, Huanggang, Taohuachong Forest Park (30°59'N, 116°02'E), 5 females, 1 male from *Liquidambar formosana* [Hamamelidaceae], 23.vi.2014 (Chao Zhao). Sichuan, Chongzhou, Anzhihe National Nature Reserve (30°48'N, 103°14'E, alt. 1600m), 5 females, 1 male from *Leonurus artemisia* [Lamiaceae], 5 females from Asteraceae, 25.vii.2016 (Baoqiang Pan). Guangxi, Jiuwanshan National Nature Reserve, Yangmei'ao (25°11'26"N, 108°38'34"E, alt. 1160m), 24 females, 2 males from *Buddleja* sp. [Scrophulariaceae], 25.vii.2015 (Zhaohong Wang).

Distribution: China (Hubei, Sichuan, Yunnan, Guangxi, Hainan), India (Tamil Nadu), Nepal.

Host plants: *Buddleja* [Scrophulariaceae]

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References

- Alavi, J.A., Minaei, K. & Fekrat, L. (2014) The Iranian Dendrothripinae (Thysanoptera: Thripidae) with description of a new genus and species. *Zootaxa*, 3860 (5), 479–486.
<https://doi.org/10.11646/zootaxa.3860.5.6>
- Ananthakrishnan, T.N. (1958) *Dendrothripiella stannardi* sp.nov. (Thysanoptera; Terebrantia) from Kodaikanal Hills (S. India). *Journal of the Zoological Society of India*, 9, 216–221.
- Ananthakrishnan, T.N. (1965) Indian Terebrantia-II (Thysanoptera: Insecta). *Bulletin of Entomology, India*, 6, 15–29.
- Bagnall, R.S. (1916) Brief descriptions of new Thysanoptera VIII. *Annals and Magazine of Natural History*, Series 8, 17 (101), 397–412.
<https://doi.org/10.1080/00222931608693804>

- Bhatti, J.S. (1971) Five new species of *Dendrothrips* Uzel, with a key to the Indian species. *Oriental Insects*, 5, 345–359. <https://doi.org/10.1080/00305316.1971.10434022>
- Chen, H.M., Zhu, L.H., Qi, R.S. & Xu, Z.C. (1994) A new recorded thrips *Dendrothrips ornatus*: its biology and control. *Acta Agriculturae Universitatis Pekinensis*, 20 (2), 171–177. [in Chinese with English abstract, http://en.cnki.com.cn/Article_en/CJFDTOTAL-NYDX199402012.htm]
- Gu, M.B. & Chen, P.Z. (1987) The component and ecologic distribution of thrips species at Jianfengling in Hainan Island. *Acta Ecologica Sinica*, 1 (7), 65–72. [in Chinese]
- Han, Y.F. (1997) *Economic Insect Fauna of China*. 55 *Thysanoptera*. Editorial Committee of Fauna Sinica, Science Press, Beijing, 514 pp. [in Chinese]
- Hoddle, M.S., Mound, L.A. & Paris, D.L. (2012) *Thrips of California 2012*. CBIT Publishing, Queensland. Available from: http://keys.lucidcentral.org/keys/v3/thrips_of_california/Thrips_of_California.html (accessed 15 January 2019)
- Jablonowski, J. (1894) Additamentum ad cognitionem Thysanopterorum. *Termesztudományi Füzetek*, 17, 93–99.
- Kudô, I. (1984) The Japanese Dendrothripini with descriptions of four new species (Thysanoptera, Thripidae). *Kontyû*, 52 (4), 487–505.
- Kudô, I. (1989) Three species of *Dendrothrips* (Thysanoptera, Thripidae) from Nepal, with description of a new species. *Japanese Journal of Entomology*, 57, 37–45.
- Marullo, R. (2003) Host relationships at plant family level in *Dendrothrips* Uzel (Thysanoptera: Thripidae, (Dendrothripinae) with a new Australian species. *Australian Journal of Entomology*, 42, 46–50. <https://doi.org/10.1046/j.1440-6055.2003.00321.x>
- Mirab-balou, M., Tong, X.L., Feng, J.N. & Chen, X.X. (2011) Thrips (Insecta: Thysanoptera) of China. *Check List (Journal of Species Lists and Distribution)*, 7 (6), 720–744. <https://doi.org/10.15560/11009>
- Mirab-balou, M., Yang, S.L. & Tong, X.L. (2014) The *Frankliniella* genus-group (Thysanoptera: Thripidae) in China, with a newly-recorded genus. *Entomotaxonomia*, 36 (2), 97–104.
- Mound, L.A. (1999) Saltatorial leaf-feeding Thysanoptera (Thripidae, Dendrothripinae) in Australia and New Caledonia, with newly recorded pests of ferns, figs and mulberries. *Australian Journal of Entomology*, 38, 257–273. <https://doi.org/10.1046/j.1440-6055.1999.00112.x>
- Mound, L.A. & Tree, D.J. (2016) Genera of the leaf-feeding Dendrothripinae (Thysanoptera, Thripidae), with new species from Australia and Sulawesi, Indonesia. *Zootaxa*, 4109 (5), 569–582.
- Mound, L.A., Collins, D.W. & Hastings, A. (2018) *Thysanoptera Britannica et Hibernica - Thrips of the British Isles*. Identic Pty Ltd, Queensland. Available from: https://keys.lucidcentral.org/keys/v3/british_thrips/index.html (accessed 15 January 2019)
- Nonaka, T. & Okajima, S. (1991) Descriptions of two new species of the genus *Dendrothrips* Uzel (Thysanoptera, Thripidae) from Japan and Taiwan. *Bulletin of the Biogeographical Society of Japan*, 46, 107–113.
- Priesner, H. (1935) New or little-known oriental Thysanoptera. *Philippine Journal of Science*, 57, 351–375.
- ThripsWiki (2019) *ThripsWiki-providing information on the World's thrips*. Available from: http://thrips.info/wiki/Main_Page (accessed 15 January 2019)
- Tyagi, K. & Kumar, V. (2016) Thrips (Insecta: Thysanoptera) of India-An Updated Checklist. *Halteres*, 7, 64–98.
- Uzel, H. (1895) *Monographie der Ordnung Thysanoptera*. Königratz, Bohemia, 472 pp.
- Wang, C.L. (1993) Two new records and two new species of thrips (Thysanoptera, Terebrantia) of Taiwan. *Chinese Journal of Entomology*, 13, 251–257.
- Xu, M.H., Wang, M.X. & Shao, Y.H. (2016) Effect of different digital colour boards on trapping *Dendrothrips minowai* Priesner. *Journal of Tea*, 42 (4), 197–198. [in Chinese, <http://www.airitilibrary.com/Publication/alDetailedMesh?docid=cy201604001>]
- Zhang, H.R., Okajima, S. & Mound, L.A. (2006) Collecting and slide preparation methods of thrips. *Chinese Bulletin of Entomology*, 43, 725–728.
- Zhang, S.M., Mound, L.A. & Hastings, A. (2018a) *Thysanoptera Chinensis. Thripidae Genera from China*. Lucidcentral.org, Identic Pty Ltd, Queensland. Available from: https://keys.lucidcentral.org/keys/v3/thysanoptera_chinensis/index.html (accessed 15 Jan. 2019)
- Zhang, S.M., Wang, Z.H., Li, Y.J. & Mound, L.A. (2018b) One new species, two generic synonyms and eight new records of Thripidae from China (Thysanoptera). *Zootaxa*, 4418 (4), 370–378. <https://doi.org/10.11646/zootaxa.4418.4.3>
- Zhang, W., Rong, J., Wei, C., Gao, L. & Chen, J. (2018c) Domestication origin and spread of cultivated tea plants. *Biodiversity Science*, 26 (4), 357–372. [in Chinese, <http://www.biodiversity-science.net/CN/abstract/abstract10491.shtml>]
- Zhang, W.Q. (1982) Preliminary note on Thysanoptera collected from Hainan Island, Guandong, China. I Subfamily: Thripinae (Thysanoptera: Thripidae). *Journal of the South China Agricultural College*, 3 (4), 48–63. [in Chinese]
- Zhang, W.Q. & Tong, X.L. (1988) The Chinese species of tribe Dendrothripini with descriptions of two new species (Thysanoptera, Thripidae). *Entomotaxonomia*, 10 (3–4), 275–282. [in Chinese, http://en.cnki.com.cn/Article_en/CJFDTOTAL-KCFL1988Z2029.htm]
- Zhao, Z.Q. (1996) Biological and ecological characteristics of *Dendrothrips minowai* Priesner. *Tea Science of Guizhou*, 67 (3), 26–27. [in Chinese]